

**hp server
rp8400**

august 2002

**adaptable,
available,
always**



a technical white paper
from
Hewlett-Packard
Company



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executive summary

Ideal for enterprises, service providers, and global e-marketplace leaders with intensive computing needs, the HP Server rp8400 represents a quantum leap in midrange computing. The rp8400 delivers high-end server technology in a midrange form factor, resulting in a server that offers the scalability, flexibility, and lasting value demanded by new business fundamentals.

scalability for the data center

Data center managers will appreciate the HP Server rp8400's unprecedented expandability, performance, and high availability. Scalable up to 16 processors, the HP rp8400 breaks new ground in midrange performance. And with an unmatched set of technologies, the rp8400 delivers industry-leading midrange high availability that virtually eliminates architecture and application vulnerability. Furthermore, the HP Server rp8400 supports HP-UX 11i—the very best enterprise operating environment (OE) for UNIX® and Itanium™-based servers.

flexibility for the IT infrastructure

IT managers will welcome the flexibility and efficiency of the HP Server rp8400. Its best-in-class dynamic partitioning and workload management solutions allow managers to adjust computing resources to workload requirements. And its optimized form factor delivers industry-leading performance density along with the lowest operational costs in the midrange market.

lasting value for all business

The HP Server rp8400 will appeal to chief information officers looking for the best return on their technology investments. HP delivers long-lasting value through easy in-box upgrades, unmatched service and support, and the industry's most innovative financing solutions, such as HP's groundbreaking utility pricing program. With utility pricing, you can choose the right financial vehicle to meet your unique business needs, selecting from pay-per-use, instant capacity on demand, and pay-per-forecast solutions.

adaptable, available, always: the hp server rp8400

figure 1. Front view of the hp server rp8400.



key features

The HP Server rp8400 supports from 2 to 16 PA-8700 or PA-8700+ processors, the latest in a long line of award-winning PA-RISC processors offered by HP. What's more, the rp8400 can be easily upgraded with Intel® Itanium Processor Family processors and new PA-RISC processors as they are developed in the future, providing customers with excellent investment protection.

The rp8400 supports 16 hot-plug PCI cards and up to 64 gigabytes of main memory. And it's packed with high availability features; like HP Superdome, the rp8400 supports hardware and software partitioning, plus online partition maintenance and upgrades (in dual-partitioned systems). It also features redundant and hot-swappable cooling units and power supplies, hot-plug disks and I/O cards, and an extremely reliable and fault-resilient main memory and cache memory subsystem.

unmatched performance and scalability

The rp8400 features performance and scalability unmatched in a midrange server offering:

- high-performance RISC processor
 - 650-MHz, 750-MHz (PA-8700), and 875-MHz (PA-8700+); 4-way superscalar CPU
 - 56-way instruction reorder buffer
 - 10 functional units
 - 2.25-MB on-chip cache (1.5-MB data cache, 0.75-MB instruction cache)
- increased memory subsystem performance
 - increased peak memory bandwidth to 16 GB/s
 - higher-density system packaging, providing 64 GB of total memory capacity
- increased processor capacity per chassis
 - configurations available from 2 to 16 CPUs
- increased I/O interface performance; more I/O connectivity
 - 64-bit 66-MHz (4X) industry-standard PCI
 - 16 independent PCI card slots
 - 8.5-GB/s aggregate I/O slot bandwidth

superior operating system

The rp8400 runs the industry-leading HP-UX 11i operating environment. HP-UX addresses the major computing challenges that customers face today in online transaction processing (OLTP), enterprise resource planning (ERP), supply chain management (SCM), server consolidation, telco billing applications, high-performance technical computing, and customer relationship management (CRM). It's also ideal for use in business intelligence systems and in Internet, scientific, and technical applications. This mainframe-class, 64-bit operating system enjoys the industry's greatest support from independent software vendors, allowing you to choose from more than 16,000 applications, including native 64-bit versions of all major databases and leading ERP applications.

flexible configuration

Whether mounted in a rack or in a standalone pedestal configuration, the rp8400 saves valuable data center space and power.

figure 2. The rp8400 saves space in its rack-mount configuration.



figure 3. The pedestal configuration is extremely flexible.



hp server rp8400 system overview

rp8400 front view

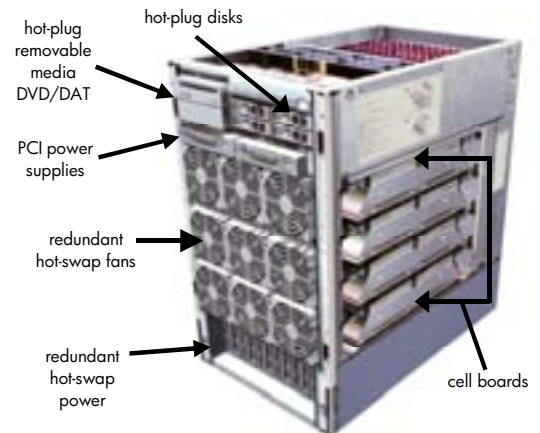
The illustrations below show major components of the HP Server rp8400, as well as the system's mechanical and architectural features.

Figure 4 shows a front view of the rp8400 with its front plastic bezel and top and left side panels removed. The illustration shows the location of major assemblies, as well as the mechanical and architectural features of the rp8400.

A peripheral bay located at the top front of the rp8400 provides space for four hot-plug disk drives and two hot-plug removable-media devices (DVD or DAT). Directly below the peripheral bay are two PCI power bricks, which supply dc power for the PCI backplane. Below the power supplies are nine redundant hot-swappable cooling fans. These fans pull cool air in from the front and force air rearward, cooling the system's internal components. At the bottom is the bulk power supply bay, which houses up to six redundant (2N+1) hot-swap power supplies.

The illustration also shows the side of the rp8400, with a view of the cell card cage. This cage supports up to four cell boards on which processors, memory, and cell controller chips reside.

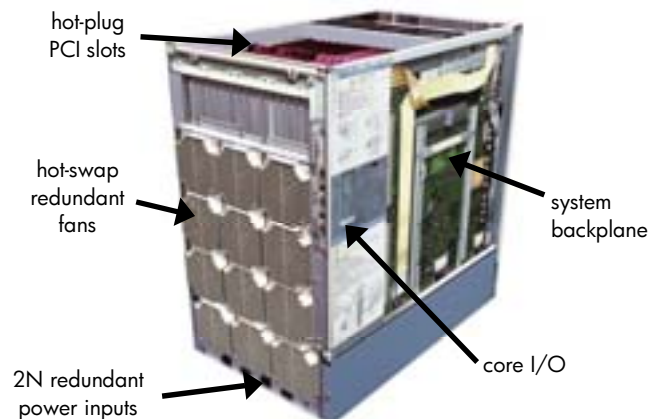
figure 4. Front and side view of the rp8400.



rp8400 rear view

Figure 5 is a rear view of the rp8400 showing the location of the 12 hot-swappable 120-mm exhaust fans and the I/O bay bulkhead directly above them. The core I/O cards are located at the right edge of the unit.

figure 5. Rear view of the rp8400



Visible here is the system backplane board, which houses the high-bandwidth crossbar used for communications between cell cards, I/O, and internal peripherals. The rp8400's I/O card bay is located at the top rear of the system. It contains 16 PCI card slots, all currently supporting hot-plug functionality.

The bottom rear of the rp8400 has inputs for the 2+2 redundant line cords. Because of the high degree of connectivity offered in the rp8400, a cable management arm is provided for dressing cables and simplifying cable routing. (The cable management arm is not shown here and is available only on rp8400 racked systems.)

hp server rp8400

features at a glance

standard features and capacities

- 1–4 CPU/memory cell boards, hot-plug
- 2–16 PA-RISC 64-bit CPUs (upgradable to 32 CPUs with future processor generations):
 - PA-8700+ @ 875 MHz
 - PA-8700 @ 650 and 750 MHz
- up to 64 GB of memory (to 128 GB with future upgrades)
- 16 PCI card slots (66 MHz x 64-bit)
- 2 core I/O cards
- built-in management processor
- integrated Web console
- up to 4 internal hot-plug disk drives (18, 36, and 73 GB)
- 2 hot-plug removable-media bays (DVD or DAT)
- easy upgrades to future PA and IPF processors

speeds and feeds

- 530-MB/s PCI link bandwidth per slot (14 of 16 slots)
- 8.5-GB/s I/O slot bandwidth (peak)
- 16-GB/s bandwidth (peak) for cell-controller-to-memory-subsystem
- 16-GB/s crossbar bandwidth (peak)

partitioning

- 1–2 nPartitions in hardware
- up to 16 virtual partitions (vPars)*

high availability

- 2N+1 redundant hot-swap power supplies
- redundant hot-swap fans, all with HP Smartfan technology
- redundant power line inputs for dual grid coverage
- error checking and correcting (ECC) on all CPU and memory paths
- ECC on all system cache memory
- main memory DRAM kill resiliency (“chip spare”)
- redundant dc-dc converters for key subsystems
- parity-protected I/O data paths

operating system

- HP-UX 11i operating environment (June 2001 release or later)
- future Linux and Windows® support with Intel Itanium Processor Family

physical characteristics

- rack-mount and pedestal configurations
- height:
 - racked chassis: 17 EIA units (29.75 in [75.56 cm])
 - pedestal chassis: 32.8 in (83.31 cm)
- depth: 30 in (76.20 cm)
- width: 19 in (48.26 cm)

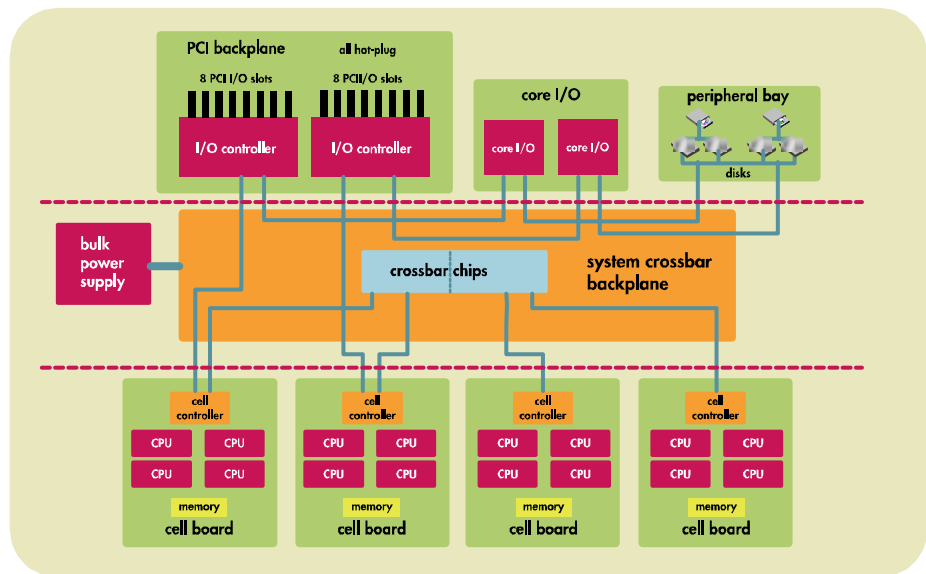
*Virtual partitions supported in the second half of 2002.

hp server rp8400 system architecture

Based on the HP Superdome architecture, the HP Server rp8400 brings high-end functionality down into the midrange. Like Superdome, the rp8400 is designed around a cell-based crossbar architecture; in the rp8400 this architecture allows it to be configured as one large symmetrical multi-processing (SMP) server or as two hardware-independent partitions. Like Superdome, the rp8400 architecture can be thought of as a set of modular “building blocks” that, when put together, form a high-performance, scalable, highly available and flexible computing platform.

There are three such building blocks in the rp8400 system architecture: the cell, the crossbar backplane, and the PCI-based I/O subsystem. **Figure 6** shows the rp8400 building blocks and the buses that connect them.

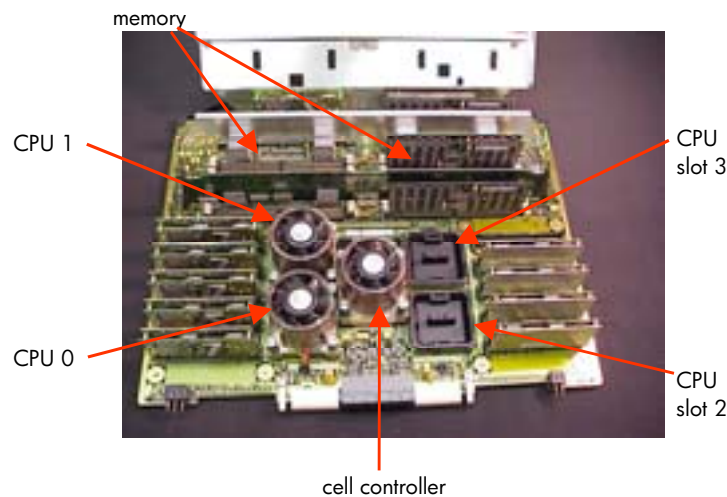
figure 6. Architecture of the rp8400, showing the basic modular “building blocks” of the system.



cell boards

The cell, or cell board, is one of the three basic building blocks of the HP Server rp8400. A cell board is a hot-plug module that primarily houses processors and memory. **Figure 7** shows the layout of the rp8400 PA-8700/PA-8700+ cell board.

figure 7. Layout of an rp8400 PA-8700/PA-8700+ cell board.



cell design details

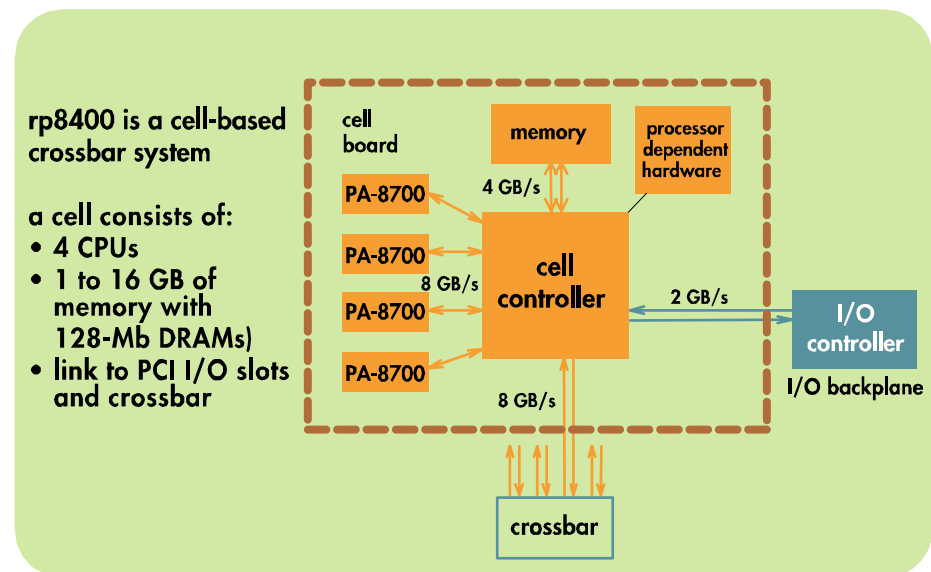
The cell controller (CC) is at the heart of each cell board. The CC provides the communications link between processors, memory, I/O, PDH (processor-dependent hardware), and the crossbar backplane. Adjacent to the CC are up to four processors and up to 16 GB of main memory, with future expansion up to 32 GB of memory. Each cell interfaces with the crossbar backplane at 8 GB/s of peak bandwidth, and CC-to-I/O-subsystem bandwidth is 2 GB/s peak. The cell controller chip contains interface logic and also maintains cache coherency throughout the system.

cell configurations

An rp8400 can contain a minimum of one and a maximum of four cells. Each cell can be purchased with two or four active PA-8700(+) processors, or with active processors in combination with instant capacity on demand (iCOD) processors.

The rp8400 supports three processor speeds: 650 MHz, 750 MHz, and 875 MHz. The ability to mix processor speeds within a chassis is supported (but processors within a cell or partition must be of the same speed). The ability to mix processor speeds provides enhanced investment protection by allowing you to add the latest available processor technology to an existing installation.

figure 8. An rp8400 cell supports up to four processors and up to 16 GB of memory, with future expansion to 32 GB.



The minimum cell configuration includes two active CPUs and 1 GB of memory per cell board. The maximum configuration includes four active CPUs and 16 GB of memory per cell board. Memory DIMM modules for the rp8400 are sold in sets of four (quads), with DIMM sizes of 256 MB, 512 MB, and 1 GB available. Memory quads of different sizes can be mixed within a chassis and within a cell. However, for optimum memory interleaving and performance, it is recommended that one memory size be selected and distributed evenly across available cells.

Within a cell the CC-to-memory peak bandwidth is 4 GB/s. Memory is accessed directly through the CC; therefore, all memory slots are accessed regardless of the number of processors in the cell.

cell hot-plug

The HP Server rp8400 supports cell hot-plug. Coupled with the server's partitioning capability*, cell hot-plug allows for the servicing of cell boards within a single partition while the other partition continues normal operation. Any number of configuration changes can be made to the partition being serviced, including replacing the complete cell board, adding or deleting CPUs and memory, or even increasing or decreasing the number of cells in that partition. (Cell hot-plug is supported only in systems with two partitions.)

* The rp8400 can be configured as a single large SMP server, or hardware-partitioned into two smaller logical servers. See "nPartitions" on page 25 for more details about partitioning.

future upgrades with cell boards

The rp8400 provides outstanding customer investment protection and lasting value with a system infrastructure that is designed to accommodate several generations of processor upgrades. And future PA-RISC and Intel Itanium Processor Family cell boards will preserve the current form factor, thus making upgrades quick and easy.

To upgrade an existing partition, the customer simply removes all the cells and the memory contained within the partition. The memory DIMMs are transferred to the new processor cells, and the new processor cells are installed into the chassis.

Today's rp8400 is ready for the next generation of processors, which means it will stay ahead of tomorrow's performance demands. Whether it's a PA-RISC or an Intel Itanium Processor Family follow-on processor, the rp8400 delivers the investment protection afforded by convenient in-chassis upgrades.

superior processor cell cooling with the turbo-cooler

One of the design objectives for the HP Server rp8400 was to deliver industry-leading performance density while maintaining high levels of availability and reliability. As one of the world's most powerful microprocessors, the PA-RISC processor and its associated core electronics require an efficient mechanism to remove excess heat. Efficient heat removal is one of the key techniques HP uses to ensure the highest levels of reliability in all of the components that make up our server computers.

The key to processor cell cooling in the rp8400 is the turbo-cooler. The turbo-cooler allows new levels of performance density and efficiency while maintaining the high levels of reliability and availability that HP customers have come to expect. The improved density provided by turbo-coolers is apparent from the compact packaging accomplished in the rp8400 cell assembly.

about the turbo-cooler

The turbo-cooler consists of a patented spiral vane heat spreader/dissipater, with an integrated Panasonic Panaflo ventilator fan nestled in the center of the fan assembly. The integrated fan has the longest life specification of any fan in its class. It includes Panasonic's proprietary Hydrowave long-life bearing, which uses a clever but simple pumping action to ensure a continuous supply of oil where it is most needed. Hydrowave bearings are over four times more robust than ball-bearing designs, and the Panaflo fan life is more than four and one-half times better than that of any competing vendor's server fans. The fan and spiral vane heat spreader/dissipater mean that turbo-coolers provide quiet, efficient cooling with outstanding reliability.

figure 9. The turbo-cooler provides quiet, efficient, and highly reliable cooling.



cooling built for reliability

The Panaflo fans used in the rp8400 actually provide demonstrated reliability that is 10 times better than that of the devices they are cooling (a reliability level that, considering the excellent reliability history of PA-RISC processors, is extremely impressive). And consider this: To rate fan life, fan vendors commonly use the “L-10” metric, which is the operating time when there is a 10 percent chance of a fan failure and a 90 percent probability that any given fan will survive. But HP engineers use a more stringent “L-1” metric; this is the operating time at which there is a 99 percent probability of survival. For the Panaflo fans used in the rp8400, L-1 is over 100,000 hours (11.4 years). And for any rp8400 fan, the probability of successful operation for shorter times is even greater—over 99.95 percent in the first year of operation.

built-in fan manageability

To further ensure that our customers will experience uninterrupted service through the life of the product with no data loss or data corruption, HP engineers have implemented sophisticated fan manageability and protection into the rp8400. Every turbo-cooler fan in this server is actively monitored and controlled. A fail-safe embedded Smartfan controller is associated with each turbo-cooler fan, affording active power management in four separate areas. These areas include two control and two reporting protocols.

Fan control is accomplished in two phases through power metering. First, the controller monitors fan speed to provide only enough power to meet cooling requirements. In this way, the fan is never over-taxed and its life is further extended. Second, should a fan begin to slow (an early sign of fan failure), this controller incrementally increases power to the fan, maintaining cooling capacity. This sophisticated control extends the fan’s capabilities beyond its specified ratings and squeezes the maximum useful life from the fan.

fan reporting

For reporting, a set of key indicators enables intelligent monitoring of fan health. Two levels of fan health are detectable. First, well in advance of failure, the controller detects fan slowing. A message is passed through system manageability tools to alert IT personnel that this fan should be replaced at the next scheduled maintenance interval—which can be up to 100 hours later. There’s no interruption in service.

Second, the embedded processor continues to monitor fan activity through the failing interval, and it transmits a higher-level message to manageability middleware when this fan slows beyond a fixed lower limit (generally after more than 100 hours). At that time, system manageability firmware instructs the operating system to perform a graceful and orderly shutdown. HP’s highest priority is the protection of data from both loss and corruption, and this graceful shutdown event is the best way to protect valuable customer data. (We’ve built a significant margin into the selection of this shutdown threshold so that even unlikely corner cases are protected.)

why turbo-coolers are best for high availability installations

Using turbo-coolers in high availability servers may be a new concept for some customers. Older fan designs, it is true, often caused single points of failure, where unreliable components caused system downtime and even data loss. But HP engineers have taken an intelligent approach that capitalizes on the positive aspects of turbo-coolers, such as improved system density and efficient component cooling, and they have reduced any issues with reliability and or availability to the point of insignificance. The turbo-cooler is a natural choice for mission-critical server products such as the rp8400.

The rp8400’s combination of superior reliability and robust system manageability protocols result in extremely high-availability cooling. And HP engineers have done extensive testing to ensure this mission critical availability comes at minimal cost.

crossbar backplane

The second basic rp8400 building block is the crossbar backplane. The crossbar backplane contains two crossbar chips that provide a non-blocking connection between four cells and their associated memory and I/O. Also located on the backplane are two PCI bus converter chips that support core I/O and internal peripherals.

crossbar chips

Two crossbar chips are part of the rp8400 system chipset. (They are also a subset of the chipset used in the HP Superdome.) Each chip implements a high-performance 8-port non-blocking crossbar and the 500-MHz crossbar link protocol. Together the two crossbar chips provide 16 high-performance ports for cell-to-cell communication, with 16 GB/s of aggregate bandwidth. All ports are functionally and electrically identical. Some of the features of the crossbar chip that contribute to performance include the following:

- support for scaling up to a 256-way Coherent Shared Memory system
- 250-MHz speed of operation
- 500-MT/s (megatransfers/second) link speed
- support for 2 interleaved channels on link protocol
- support for double-length data packets for IPF mode
- performance counters to enable software tuning

memory latency

There are two types of memory latencies within the rp8400 system:

memory latency within the cell—This latency refers to the case where an application runs on a partition that consists of a single cell.

memory latency between cells—This type of latency is present when the partition consists of two cells. In this case half of the addresses are to the memory on the requesting processor’s cell, and the other half of the addresses are to the memory of the other cell.

Memory latency in the rp8400 depends on the number of CPUs and the location of their corresponding cell boards. Assuming that there is equally distributed access to all memory controller, and that cell boards are installed to minimize latency, the average memory latency (load-to-use) is shown here:

number of CPUs	average memory latency
4-CPU	260ns
8-CPU	320ns
16-CPU	350ns

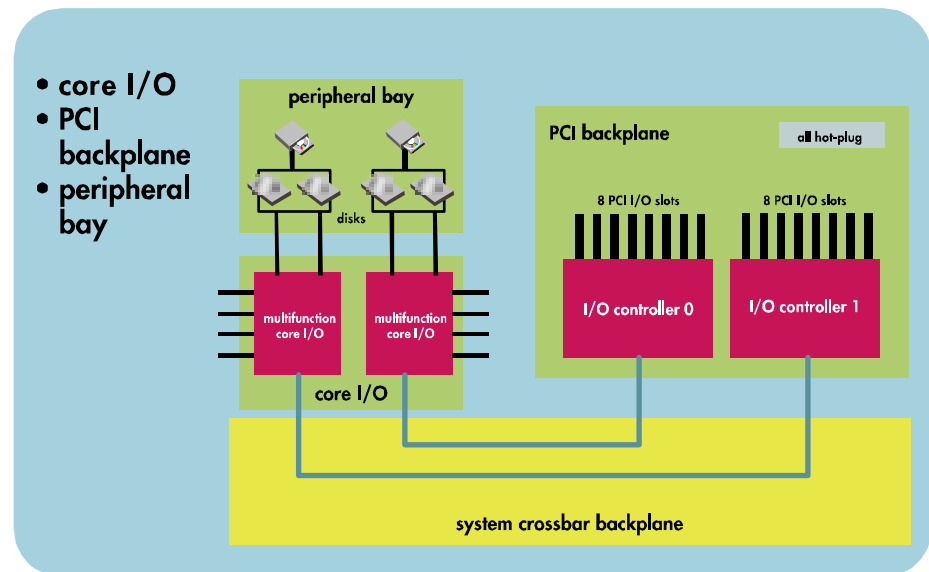
The idle memory latency—that is, the latency when the system is idle—is shown in this table:

number of CPUs	average idle memory latency
4-CPU	200ns
8-CPU	250ns
16-CPU	295ns

I/O subsystem

The I/O subsystem is the third basic building block of the rp8400. Components within the I/O subsystem are the I/O controllers, internal peripheral bay, and multifunction core I/O. **Figure 10** shows the basic block diagram of the I/O subsystem.

figure 10. Basic block diagram of the rp8400 I/O subsystem.



I/O controller chips

The rp8400 contains two master I/O controller chips located on the PCI backplane. Each I/O controller contains 16 high-performance, 12-bit-wide links; these links connect to 16 slave I/O controller chips supporting the PCI card slots and core I/O.

In the rp8400, two links—one from each master controller—are routed through the crossbar backplane and are dedicated to core I/O. The remaining 30 links are divided among the sixteen “4X” 66-MHz x 64-bit PCI card slots*, with each slot on a PCI bus by itself. This one-card-per-bus architecture leads to greater I/O performance, better error containment, and higher availability.

Each controller chip is also directly linked to a host cell board. This means that at least two cell boards, located in cell slots 0 and 1, must be purchased in order to access all 16 I/O card slots. (With one cell board, access to eight slots is enabled.)

core I/O boards

The rp8400 can be purchased with either one or two core I/O boards. The core I/O boards are identical and provide console, SCSI, serial, and management processor functionality. If you opt for the second core I/O board, it can be used to enable dual partitioning in the rp8400 and provide access to a second set of disk drives and removable-media devices.

The internal peripheral bay is divided into two identical halves. Each half supports up to two low-profile disks and one removable-media device. A SCSI controller chip located on each core I/O board supports each half of the internal peripheral bay. (This means that you must have both core I/O boards in order to access both halves of the peripheral bay.)

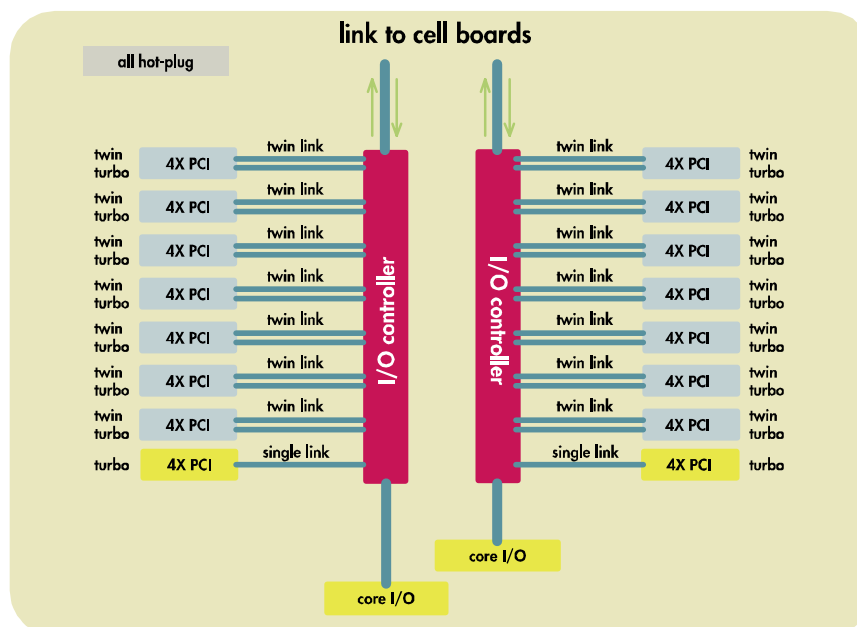
PCI backplane

Figure 11 shows a more detailed view of the PCI backplane. Note that 14 of the 16 I/O card slots are supported by dual high-performance links. These dual-link I/O slots are called “twin-turbo” slots because both links operate at turbo speeds—that is, each offers 265 MB/s of bandwidth—providing a maximum of 530 MB/s (peak) bandwidth for the slot. The remaining two I/O slots are single links and are designated as “turbo slots.” Aggregate I/O slot bandwidth is 8.5 GB/s.

Every PCI slot in the rp8400 is capable of running at 66 MHz x 64 bits—known as “4X” PCI by HP. This means that each rp8400 I/O slot will allow the industry’s highest-performing PCI cards to run at their maximum design speed.

* 66-MHz x 64-bit slots are known as “4X” slots.

figure 11. The rp8400's PCI backplane has dual high-performance links for 14 of the 16 I/O card slots.



In practice, PCI I/O cards requiring the largest amount of bandwidth should be configured into the twin turbo slots. Because each core I/O and I/O slot has a dedicated bus, any slot can be hot-plugged or serviced without affecting other slots.

The rp8400 I/O card slots are keyed for either 3.3-volt or 5-volt PCI cards. There are 14 slots keyed for 3.3 volts, and these support either 3.3-volt or universal PCI cards. The remaining two slots are keyed for 5 volts and support either 5-volt or universal PCI cards.

All cards on the rp8400's list of supported cards are universally keyed. Therefore, any supported card will work in any slot. In the future, higher-performing PCI and PCI-X cards will be keyed for 3.3 volts.

supported cards

HP strives to provide the latest in I/O technology, offering customers greater performance and connectivity, and the rp8400 supports an extensive list of industry-standard PCI I/O cards. The list below contains the list of I/O cards supported at the first release of the rp8400. The maximum number of each card per system is 16, except as noted.

mass storage

- single-port PCI 2X Fibre Channel
- single-port Ultra2 SCSI
- Ultra2 SCSI RAID (maximum 12 cards per system)
- dual-port F/W SCSI-2
- single-port F/W SCSI-2

local area network (LAN)

- single-port 1000Base-SX Ethernet LAN
- single-port 1000Base-T Ethernet
- 4-Port 100Base-TX Ethernet
- single-port 100Base-TX Ethernet
- FDDI dual attach station
- ATM 622-Mbps MMF
- ATM 155-Mbps UTP or MMF
- 802.5 Token Ring 4-, 16-, 100-Mbps operation

combination cards

- 2-port Ultra2 SCSI/2-port 100Base-T combo card

wide area network (WAN)

- 2-port X.25/frame relay
- 4-port X.25/frame relay

serial multiplexer cards

- 64-port MUX
- 8-port MUX

cluster interconnect

- Hyperfabric 4X interconnect2 (maximum 4 cards per system)
- Hyperfabric 2X interconnect (maximum 4 cards per system)

encryption

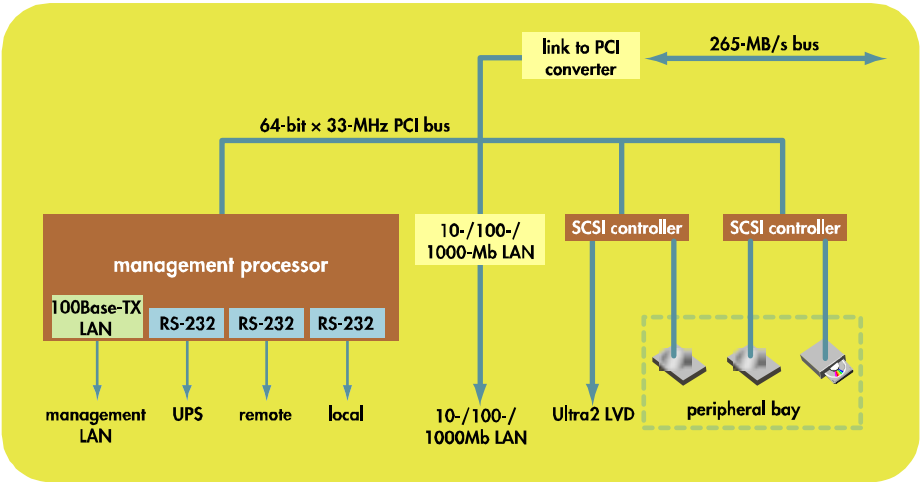
- HP Speedcard

New I/O cards are added regularly. For the latest list of supported I/O cards, please refer to the online version of the *HP Server Configuration Guide*.

core I/O

The rp8400 chassis supports up to two core I/O cards, installed in core I/O slots located along the right-rear vertical edge of the chassis. A minimum of one core I/O card must be ordered with each system; the optional second core I/O card can be used to enable hardware partitioning or to utilize the full capacity of the built-in mass storage bays.

figure 13. Block diagram showing the basic core I/O in the rp8400.



Each rp8400 core I/O card has a management processor, external LAN port, and external SCSI port, and each supports access to the internal peripheral bay.

management processor

The management processor (MP), located on each core I/O card, is a dedicated processor that simplifies and extends system management and also enhances serviceability. The MP minimizes or eliminates the need for the system administrator to be physically at the system to perform tasks such as diagnostics, system management, or even hard resets. Here are some of the features enabled by the rp8400 management processor:

- system management over the Internet or intranet
- system console redirection
- console mirroring
- system configuration for automatic restart
- viewing history log of system events
- viewing history log of console activity
- setting MP inactivity timeout thresholds
- remote system control
- remote power cycle (except for MP housekeeping power)
- viewing system status
- event notification to system console, e-mail, pager, and/or HP Response Centers (e-mail and pager notification work in conjunction with HP's Event Monitoring Service [EMS]).
- automatic hardware protection from critical environmental problems
- access to management interface and consoles on WAN failure (modem required)
- automatic system restart
- remote resetting of hardware partitions
- forward progress indicator (via a virtual front panel)
- out-of-band manageability and processor-dependent code (PDC) firmware update
- configuration of manageability and console security
- Secure Sockets Layer (SSL)

external LAN port

The external LAN port is a 10/100/1000Base-T external LAN port using an RJ45 connector.

external SCSI port

The external SCSI port is an Ultra2 LVD external SCSI port for connections to mass storage or media.

access to internal peripheral bay

The first core I/O card enables half of the rp8400 peripheral bay, which includes one removable-media and two low-profile disks. The second core I/O card enables the remaining internal peripherals, two disks, and one removable-media bay. Customers who require access to more than two internal disks or more than one removable-media slot will need the second core I/O card and a minimum of two cell boards.

internal peripheral bay

The rp8400 internal peripheral bay is located at the top front of the system chassis. The peripheral bay holds up to four low-profile hot-plug disks and two hot-plug removable-media devices.

Each rp8400 core I/O card contains two dual-channel SCSI controller chips that support the SCSI devices in the internal peripheral bay. Each core I/O card supports two internal disks and one removable-media device, each on a dedicated 40-MB/s SCSI channel. If use of more than two internal disks or one removable-media device is needed, the rp8400 will require both core I/O cards. This architecture also provides an added degree of availability in that full disk mirroring is supported across independent buses, controllers, core I/O cards, and master I/O controller chips.

hot-plug disk drives

The rp8400 holds four embedded SCSI disks, which are accessible from the front of the server. These are hot-plug disks, so they can be removed and inserted while the rp8400 continues to operate. Three disk sizes are currently supported: 18-GB, 36-GB, and 73-GB.

removable-media bays

The rp8400 contains two removable-media bays, which support either a DVD-ROM or DDS-4 DAT drive. Access to these devices is also from the front. The DVD-ROM drive provides enhanced features while preserving backward read compatibility with CD-ROM drives. Data transfer rates of up to 6.75 MB/s are achieved with the DVD format; 4.8 MB/s can be achieved using the CD-R format. The DDS-4 drive has a maximum storage capacity of 40 GB, with a peak transfer rate of 21.6 GB/hour (compressed).

A dedicated SCSI bus supports each removable-media bay. This configuration allows for either the DVD or DAT drive to be hot-plugged without interrupting server operation.

I/O configuration guidelines

The following table summarizes the configuration rules for the use of I/O slots and internal peripherals in the rp8400.

configuration	minimum requirements	
	minimum number of cells	minimum number of core I/O cards
>8 I/O card slots	2	1
>2 internal disks	2	2
2 internal removable-media devices	2	2
2 partitions	2	2

ac power subsystem

requirements for fault-tolerant power compliance

The HP Server rp8400 is one of only two midrange servers (the other is the 8-way HP Server rp7410) to be certified with no deviations by The Uptime Institute under its Fault Tolerant Power Compliance Specification.

The rp8400 hardware is capable of receiving ac input from two different ac power sources. The objective is to maintain full equipment functionality when operating from power source A and power source B, or from A alone or B alone. This capability is known as “fault-tolerant power compliance.”

According to the Uptime Institute’s Site Uptime Network specification, for equipment to qualify as being truly fault-tolerant power-compliant, it must meet all of the following criteria as initially installed and as ultimately used in operation:

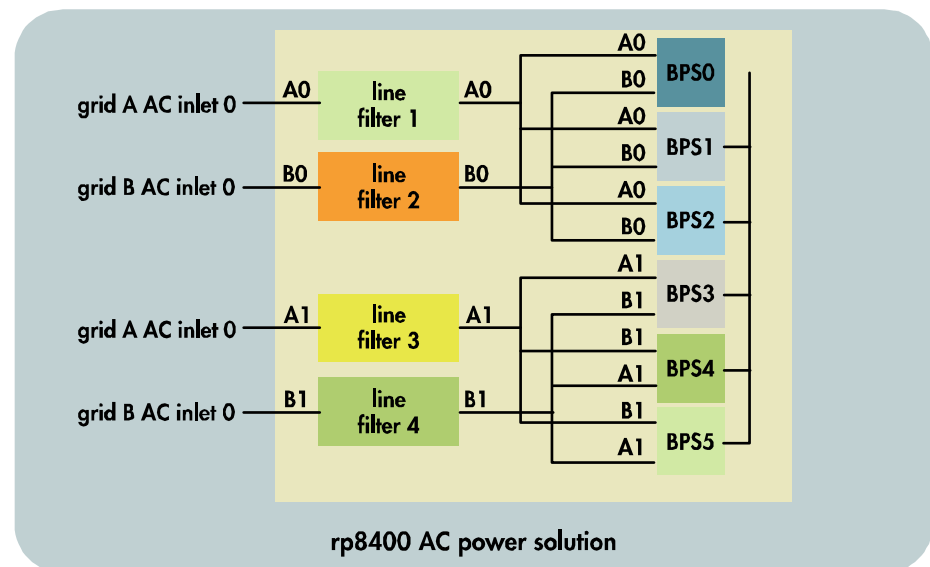
- If either one of two ac power sources fails or is out of tolerance, the equipment must still be able to start up or continue uninterrupted operation with no loss of data or reduction in hardware functionality, performance, capacity, or cooling.
- After the return of either ac power source from a failed or out-of-tolerance condition during which acceptable power was continuously available from the other ac power source, the equipment will not require a power-down, initial program load (IPL), or human intervention to restore data, hardware functionality, performance, or capacity.
- The first or second ac power source can fail one second after the return of the first or second ac power source from a lost or out-of-tolerance condition with no loss of data, hardware functionality, performance, capacity, or cooling.
- The two ac power sources can be out of synchronization with each other, with different voltages, frequencies, phase rotations, and phase angles, as long as the power characteristics for each separate ac source remain within the range of the manufacturer’s published specifications and tolerances.
- Both ac power inputs will terminate within the manufacturer’s equipment. Internal or external active input switching devices (such as static transfer switches) are not acceptable.
- A fault inside the manufacturer’s equipment that results in the failure of one ac power source will not be transferred to the second ac power source, causing it to also fail.
- An internal uninterruptible power system (UPS), internal power batteries (batteries for cache memory are acceptable), or other type of energy storage equivalent is allowable only for the purpose of a prompt, orderly shutdown. The existence and voltampere (VA) capacity of an internal UPS or batteries and the time required for a prompt, orderly shutdown must be identified.
- With both ac power inputs available, the power provided by each of the two internal power trains will be $50\% \pm 10\%$ of the power output for the supply.
- An external software alarm must be provided via the equipment’s software or the host’s operating system when an ac power source is lost or is outside the manufacturer’s published tolerances, and the software must also indicate when the abnormal condition is corrected.

fault-tolerant power compliance in the rp8400

The ac input to the rp8400 has been divided into four separate circuits. Each circuit can be fed by any 50- to 60-Hz high line source through four line cords. ("High line" refers to 220–240 volt operation.) A minimum of two power cords must be used to maintain normal operation of the rp8400. A second set of two cords can be added to improve system availability by protecting, for example, against power grid failures or accidentally tripped circuit breakers. This power is routed from four individual 20-ampere circuit breakers via input line filters to six internal bulk power supplies (BPSs). These four lines are labeled A0, B0, A1, and B1 at the line filter inputs on the back panel of the rp8400.

Figure 14 shows the rp8400 power configuration. Note that each ac inlet feeds three rp8400 bulk power supplies and that two separate ac inlets feed each bulk supply. The design of the individual BPSs and the configuration of the interconnect meet all the conditions listed above for fault-tolerant power compliance.

figure 14. Power inputs and interconnects in the rp8400 are designed for fault-tolerant power compliance.



features of the ac power system

The rp8400 ac power configuration has several salient features designed for the convenience of the user. First, and most important, are the four 16-/20-ampere power cords used for 2N power. At first glance, it may appear that using two higher-amperage cords would have been better. HP considered this solution but rejected it because this would have required either two 30-ampere 3-phase cords or two 40-ampere single-phase cords. Research has shown the many customers do not have three-phase power in their data centers, and some countries don't allow 40-ampere single-phase branch circuits. In short, using four lower-amperage cords is the only solution that will fit all data centers.

For customers who prefer to use just two cords for 2N power, HP has designed a 60-ampere rack-mounted power distribution unit (PDU). The PDU consolidates the rp8400 cords into a configuration with a single cord per grid. For more information about the PDU, see page 23.

In the rp8400, the 20-ampere circuits provide:

- flexible, manageable, small-radius cables to and inside the cabinet containing the rp8400 system
- economical cables, plugs, receptacles, and wiring that keep costs down
- easy system installation because of the general availability of 20-amp circuits
- manageable cabinet internal wiring, coupled with the ability to use just two single high-amperage cables for mains power to the cabinet, via the addition of large-amperage cabinet-housed PDUs.

20-amp circuits

dual ac modular bulk power supplies (BPS)

Each BPS shown in **Figure 14** can be thought of as two sub-power supplies housed in a single BPS module. If only Grid A power cords are used, only one of the two sub-power supplies is in use. The other supply sits idle until a second set of Grid B cords is used. The benefit of this design is that when utilizing all four power cords, the rp8400 has 2N+1 redundant dc power protection.

The dual ac modular power supplies provide:

- the ability to purchase only the amount of power conversion necessary for the intended rp8400 configuration
- redundancy for both hardware failures and power input failures
- hot-plug capability for any BPS in a redundant configuration
- better data security, maintenance scheduling, and maintenance operations without system interruption

ac power consumption

The HP Server rp8400 power consumption varies greatly, depending on the hardware configuration and the input line voltages supplied at the customer site. Because energy efficiency is of such high importance all over the world, HP represents power consumption in terms of voltamperes (VA). There are two ways to represent consumption:

- **theoretical maximum value**—represents the maximum wattage of a given configuration, assuming worst-case conditions (thermal tolerances, workloads, and so forth) on all system components. It is extremely unlikely that any customer will experience power consumption at the level specified as the theoretical maximum.
- **typical value**—represents the expected power consumption of a given configuration. The typical value is the approximate power consumption that a customer will most likely experience and can use for power budgeting purposes.

Following are the theoretical maximum and typical power consumption values for two different rp8400 configurations:

fully loaded rp8400 configuration

The rp8400 fully loaded configuration consists of sixteen 875-MHz PA-8700+ processors, 64 GB of memory, 16 PCI cards, four cell boards, four internal hard drives, two DVD drives, two core I/O cards, and six bulk power supplies.

- theoretical maximum power consumption: 5,035 VA (25.2 A @ 200 Vac)
- typical power consumption: 3,046 VA (15.2A @ 200 Vac)

average rp8400 configuration

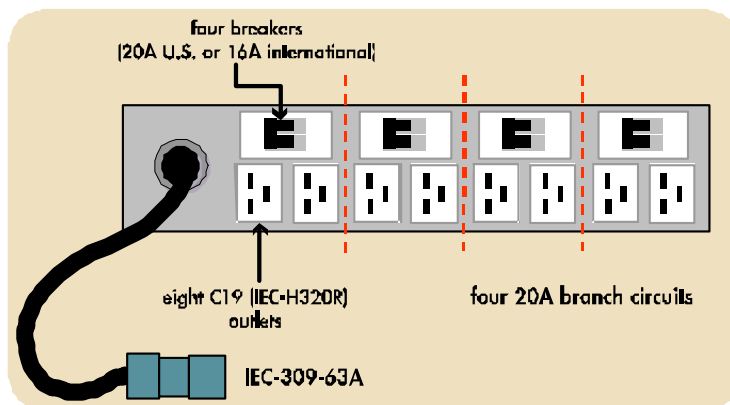
The rp8400 average configuration includes eight 875-MHz PA-8700+ processors, 16 GB of memory, eight PCI cards, two cell boards, two internal hard drives, one DVD drive, two core I/O cards, and four bulk power supplies.

- theoretical maximum power consumption: 2,550 VA (12.8A @ 200 Vac)
- typical power consumption: 1,675 VA (8.4A @ 200 Vac)

60-ampere power distribution unit

Customers who prefer fewer but higher-amperage connections from their ac line current source to the rp8400 can use the 60-ampere power distribution unit (PDU). This PDU is designed to fit horizontally in a standard 19-inch cabinet, and it occupies just three EIA units of racking space. This PDU is sold separately and can be ordered with any HP server solution. PDU product numbers are E7683A (North America) and E7684A (international). **Figure 15** shows the 60-ampere PDU.

figure 15. The 60-ampere PDU provides four breaker protected outlets from a single ac line input.

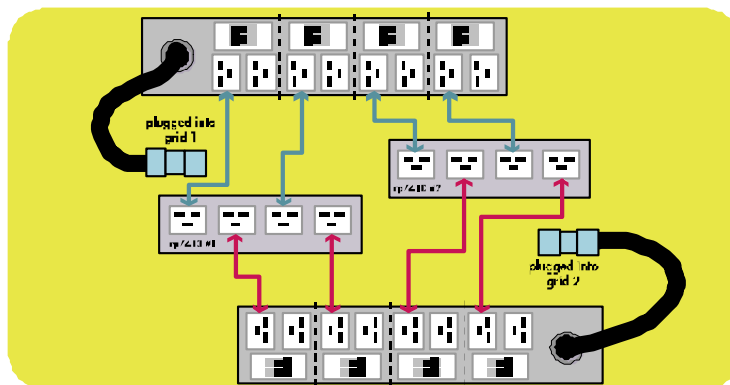


Each 60-ampere PDU contains eight C19 outlets spread evenly among four 20-ampere branch circuits (two C19 outlets per branch). Each of the four branch circuits is protected by a circuit breaker that is either 20 amperes (United States) or 16 amperes (international). All 60-ampere PDUs are delivered with an IEC-309-63A plug.

The maximum amperage is 60 amperes through the entire PDU and 20 amperes per breaker. Both limits must be met. If 20 amperes are being drawn per breaker, only three sets may be used.

Figure 16 illustrates an example of using 60-ampere PDUs to configure redundant power for two rp8400 servers.

figure 16. Configuring two rp8400 servers with two 60-amp PDUs for redundant power.



The blue cords (that is, the top four double-headed lines) are the primary power connections needed for normal operation. In this example, both primary connections from each server are plugged into separate branch circuits. The remaining PDU outlets can be used to power other components, as long as the rating of 16/20 amperes per PDU branch circuit breaker and 60 amperes per PDU is not exceeded.

For redundant power inputs, the red cords (the bottom four double-headed lines) are added. These represent secondary power connections. If, as shown in the figure, the second PDU is plugged into a second grid, this configuration provides protection against:

- losing power from a single power grid
- accidental tripping of one or two circuit breakers
- accidental disconnection of a single PDU power cord
- accidental disconnection of up to two power cords per system

performance and scalability

The HP Server rp8400 brings leading-edge performance and scalability to the midrange server market. At first release, the rp8400 already has an industry-leading OLTP performance benchmark. When density is added to the equation, the compact rp8400 offers performance density at least twice that of the competition. For example, two rp8400 servers fit into a single HP cabinet, with room to spare for 2.4 TB of storage. Competitive systems, on the other hand, require at least two cabinets, or even four, to equal the rp8400 performance.

Designed to scale well into the future, the rp8400 has plenty of headroom to support a long list of future upgrades. Several generations of processors, including Intel Itanium Processor Family and dual-die processors, will be supported. In addition, more memory, I/O, and manageability features will be added at each release, further improving performance and scalability.

This section summarizes the main performance and scalability characteristics of the rp8400.

important speeds and feeds

Crossbar bandwidth (peak)	16 GB/s
Cell-controller-to-I/O-subsystem bandwidth (peak)	4 GB/s
I/O slot bandwidth (peak)	8.5 GB/s
Memory bus bandwidth (peak)	16 GB/s

scalability

Hot-plug cell boards	1–4
CPUs	2–16
Memory	1–64 GB
Hot-plug PCI I/O slots	16 slots (64-bit x 66 MHz)
Partitions	1 or 2
Hot-plug internal disks	0–4 (18- or 36-GB disks)
Hot-plug removable media	0–2 (DVD or DAT)

performance benchmarks

The HP server rp8400 offers leadership performance in the OLTP, business intelligence, and technical markets. More information will be available as benchmarks become certified.

performance considerations and configuration rules

In order to achieve top performance with the rp8400, a few rules apply:

configuration	applies to	details
A cell should be configured with a multiple of eight DIMMs.	Cell (memory)	Eight DIMMs are required in order to populate both memory buses. There may be additional interleaving and/or bandwidth benefits to populate more rows. Populating only one memory bus (four DIMMs on a cell) delivers half the available bandwidth.
All cells in a partition should have the same amount of memory (symmetric memory loading).	Cell (memory)	Asymmetrically distributed memory affects the interleaving of cache lines across the cells. Asymmetrically distributed memory can create memory regions that are non-optimally interleaved. Applications whose memory pages land in memory interleaved across just one cell can see up to four times less bandwidth than applications whose pages are interleaved across all cells.

racking

The HP Server rp8400 provides industry-leading performance density and availability in a racked configuration. At 17 EIA units (29.75 inches) each, two rp8400 servers can be mounted into a single HP two-meter cabinet, with 7 EIA units of extra space for mounting external peripherals.

The rp8400's industrial design and packaging allow easy and quick access to all of the system's components. The most frequently handled removable-media devices and disks are directly accessible at the system's front. Removing the front bezel allows complete servicing of hot-swap fans, hot-swap power supplies, and PCI power supplies. At the rear, core I/O and more hot-swap fans are directly accessible.

For access to all other components, the rack-mounted rp8400 comes with rack slides. These enable it to slide forward out of the cabinet for servicing of internal components such as fans, cell boards, and I/O cards—even while the system is still operating.

The slides also allow for servicing or replacement of any FRU (field replaceable unit) without removing the chassis from the cabinet. In fact, you can access and remove any FRU within 15 minutes or less. This design minimizes the downtime associated with system upgrades in the rare event of a component failure.

Also included with every rack-mounted rp8400 is a cable management arm (CMA). The CMA neatly secures data cables and prevents them from becoming entangled while the system is being serviced.

ballast kits

For stability during servicing, ballast kits are used on HP cabinets in which the rp8400 is installed. Every rp8400 shipped to customers, excluding pedestal models, includes a ballast kit. The ballast easily attaches to the rear anti-tip foot that comes standard with every HP Rack System cabinet. Use of the rp8400 ballast kit is mandatory for safety and for warranty validation, and the kit should be installed immediately.

third-party racks

HP servers are designed to maximize performance density when installed into HP system cabinets. Moreover, HP system cabinets maintain the high level of safety and reliability that customers have come to expect. Although HP strongly recommends racking the rp8400 in HP cabinets, we recognize that some customer circumstances may prohibit this. So HP has developed guidelines that enable safe, reliable HP server installations in third-party cabinets. Because of the wide variety of cabinets in the marketplace, it is extremely important that the guidelines be followed explicitly. (See chapter 4 in the September 2001 or later version of the *HP Server Configuration Guide* for the racking guidelines.)

nPartitions

The HP Server rp8400 offers the same mainframe-style partitioning capability introduced in the HP Superdome server. When coupled with the HP-UX operating environment, partitions in the rp8400 allow a single system to be logically divided into two independent systems within the same server.

Partitions in the rp8400 are referred to as nPartitions; the “n” indicates that a partition actually has a wide number of functions that it can perform. These nPartitions provide a degree of isolation that can be utilized to consolidate several applications on a single server, give flexibility in resource management, and deliver improved availability and scalability.

how partitions work

A hardware partition corresponds roughly to a single, standalone system. The rp8400 can be subdivided into two partitions, each containing one or (usually) more cells that communicate coherently over a high-bandwidth, low-latency crossbar fabric. Cells are grouped into physical structures called cabinets or nodes.

Special programmable hardware in the cells defines the boundaries of a partition in such a way that isolation from the actions of other partitions is enforced. Each partition runs its own independent instance of the operating system (at first release, HP-UX 11i only). Non-clustered applications cannot span partitions, since each partition runs its own instance of the OS—essentially functioning as a standalone server. However, different partitions may be executing the same or different revisions of an operating system. And at a future date, when Intel Itanium Processor Family processors are available on the rp8400, different partitions will be able to execute different operating systems—such as HP-UX, Windows NT®, and Linux—any two at one time.

Each partition has its own independent CPUs, memory, and I/O resources, consisting of the resources of the cells that make up the partition. Commands that are part of the system management interface allow resources to be removed from one partition and added to another without having to physically manipulate the hardware. With a future release of HP-UX, using the related capabilities of dynamic reconfiguration (for example, online addition and online removal), you will be able to add new resources to a partition or remove and replace failed modules while the partition continues in operation.

The maximum number of cells in a single partition is four and the minimum is one. Each partition must contain at least one cell that is attached to a core I/O card.

nPartition configurations

As previously mentioned, the rp8400 can be divided into two independent hardware partitions. In a partitioned configuration, system resources such as I/O slots, core I/O, disks, and removable-media devices are evenly split between the two partitions. There is no flexibility to otherwise divide these components. For example, it is not possible to include 12 I/O slots in partition 0 and four I/O slots in partition 1; the split must be even.

On the other hand, cell boards and their sub-components (processors and memory) can be unevenly divided in a partitioned system. The basic rule is that cell 0 and cell 1 must be in separate partitions; after that, cells 2 and 3 can both be assigned to partition 0, or both to partition 1, or divided between the two partitions. The following table summarizes the resource split between hardware partitions.

	cells (req)	I/O slots	core I/O (req)	disk/media bays	optional cells
Partition 0	Cell 0	8	1	2/1	Cell 2 and/or 3
Partition 1	Cell 1	8	1	2/1	Cell 2 and/or 3

reconfiguring partitions

You can increase or reduce the processing power of a partition by adding or deleting cells. (For the first release of the rp8400 with HP-UX 11i, you must shut down the operating system running on the affected partitions before moving cells, and before configuration changes will take effect.) Though HP-UX 11i does include commands for some configuration tasks, HP recommends you use the Partition Manager (parmgr) to configure partitions.

The combination of the rp8400 and HP-UX 11i supports hardware partitioning. Hardware-based partition configuration changes may require a reboot of the partition, depending upon the configuration change. The reboot of the partition only affects the partition that is being reconfigured; the other partition is not affected and will continue to execute without interruption.

dynamic reconfiguration

In a future HP-UX release, dynamic hard partitions will be supported. Dynamic partitions mean that partition configuration changes do not require a reboot of the partition. Virtual partitioning within HP-UX 11i also provides additional options for dynamic reconfiguration without having to reboot the changed partition.

uses for nPartitions

One of the primary advantages of nPartitions is their support for flexible, user-defined partitioning of resources. They also isolate hardware and software errors. Here are some of the typical types of nPartitions:

- **OS partitions**—A partition can run various operating environments such as HP-UX, Windows NT, and Linux. (Only HP-UX is available at first release.)
- **OS version and functional partitions**—Partitions on a system can run different versions of the same operating system, and each can have a specific function (for example, a database partition, an application partition, a development partition, a production partition, and so on).
- **high-availability partitions**—Partitions can participate in an MC/Serviceguard cluster, with applications failing over from one partition to another.
- **application partitions**—A partition hosting a specific application can provide dedicated resources, such as memory space.
- **floating partitions**—Applications will be able to take advantage of policy-based workload balancing across partitions (not supported at first release).
- **virtual partitions**—Partitions can support workload consolidation and software isolation with better granularity (for example, to the individual CPU level).

more details about some key uses for nPartitions

Partitioning resources provides extraordinary flexibility in configuration and operation. Partitions mean you can allocate physical resources and tune the operating system running on each partition depending on the needs of the application (or the most important application) you intend to run on it. Alternatively, you can configure the rp8400 as a single partition, allowing all the resources to be focused on a single set of tasks—for example, a large online transaction-processing application.

This section gives more details about some of the most popular and effective uses for nPartitions.

resource partitioning

Today, businesses require that multiple applications running on the same server deliver full performance and do not conflict or interfere with one another. For top performance, it is critical that the actions of one application not adversely impact or result in the denial of service to other applications. Furthermore, a failure in the operating system or hardware components on the server supporting a particular set of applications must not result in the loss of multiple applications running on that server.

In order to have effective consolidation of applications on a single server, an application must not be allowed to use a disproportionate share of system resources needed by another application, and the failure of a hardware component must not result in the loss of service for multiple applications. While a solution to these problems could be accomplished by providing multiple servers at a site, such a method is inflexible in the face of changing requirements, is more expensive, and requires more space in the data center. Instead, the IT department needs a flexible configuration that offers the capability to adjust compute resources in a dynamic fashion while still preserving the symmetric multiprocessor (SMP) programming model.

That's why nPartitions are so effective at resource partitioning. With rp8400 nPartitions, each partition is isolated from the other with special, dynamically configurable hardware that provides an effective firewall between applications. There is no possibility of interference between nPartitions.

With nPartitions, the system manager has the control necessary to optimize the allocation of resources to competing workloads. For example, as workloads change through the daily cycle, the manager can deploy system resources to optimize interactive performance applications during normal business hours. When peaks of interactive activity occur, additional resources can be added to cover the load. As the interactive load diminishes, resources can be returned to favor batch or other workloads. At any time, the administrator can select cells and move them from one partition to another in order to support resource requirements in a specific partition. And the movement of resources can even be accomplished automatically through the use of control scripts.

multiple environments

Business requirements and competitive pressures can dictate the need for a large set of applications—both old and new. Often applications require different versions or revisions of operating systems, different system parameter settings, and even different patch levels. And performance can suffer from the interactions of applications with incompatible behaviors.

But nPartitions can solve the problem of different versions or revisions by running multiple environments. With these partitions, a portion of the compute and I/O resources can be configured to run an old copy of the operating system while the rest of the machine is updated to run the newer software. Such a scheme can also be used to set up a test environment where new software and operating systems can be installed, while leaving production applications to continue operations without being affected.

Similarly, two HP Server rp8400 platforms can be set up such that each one runs the prime partition of an MC/Serviceguard cluster as well as the backup partition of the other's prime partition. This eliminates single points of failure between the prime and backup partitions.

improved availability

Another use for nPartitions is to provide independence of failure or operation. If one partition must be rebooted or taken down to perform an operating system upgrade, the other partition in the system is not affected.

Unlike a traditional large SMP, nPartitions allow a server to be configured into a cluster of independent systems. Since failure independence is provided by nPartitions, it is possible to configure high availability clusters within the same complex, with each cluster consisting of two or more partitions. In order to achieve maximum availability, the partitions making up the cluster can be configured as high-availability partitions on different nodes; this ensures that no single hardware or software failure can affect another cluster member, yet it retains the configuration flexibility of a single pool of system resources.

more flexible scaling

Some applications may not have the ability to scale linearly with large numbers of CPUs. However, nPartitions enable processors, memory, and I/O resources to be tailored to match application-scaling characteristics. Moreover, as new application or operating system releases provide improved scaling characteristics, nPartitions allow resources to be readjusted to optimize application performance.

Here's just one example: You could start off with an rp8400 configured with a pair of 8-way SMP HP-UX partitions and, later, re-allocate the server's resources to a 12-way SMP HP-UX partition and a 4-way partition dedicated to Windows NT. Your hardware investment is protected even if the hardware is re-allocated to a different operating system or application set with different scaling properties.

what you gain with nPartitions

To sum up, the major benefits of nPartitions are:

- increased server manageability and flexibility
- reduced total cost of ownership
- increased availability for mission-critical applications

Other benefits include:

- independent resource controls, I/O, and security in each partition
- ability to run multiple applications and/or different operating systems on a single system, enabling the best use of computing resources while providing software fault and security isolation
- protection against software errors—a software error in one partition (including an OS failure) will not bring down other partitions within the server
- protection against hardware errors in other nodes—a hardware error in a separate coherent node will not bring down a partition in any other node
- protection against hardware errors in the same node—most hardware errors in the same node will not bring down a peer partition in the same node
- protection against downtime due to configuration changes in another partition—configuration changes in a different partition (such as online replacement or addition of a component, reboot, shutdown, and so on) will not affect other active partitions on the same or a different node

high availability

High availability (HA) is the hallmark of HP computer systems. But HP knows that delivering solutions that fully enable the “always-on,” 24 x 7 operations demanded of today’s businesses requires more than just delivering laundry lists of unusable HA features—or HA features with limited utility. The high availability features of the HP Server rp8400 actually address the *real* causes of customer downtime, as determined by actual field data from midrange computer users.

The HA features of the rp8400 can be classified as those that address *per-partition reliability* and those that address *intra-partition reliability*—that is, single points of failure between hard partitions.

partition reliability

The rp8400 has a design that is significantly “hardened” over other systems in its class. In fact, many of the features in this midrange system can only be found in mainframes (or HP Superdome). The reliability features within each rp8400 partition have been field-proven to provide high system reliability. And many customers who have taken advantage of these features report significantly lower hardware failure rates than with competitive systems.

CPU protection

The central processing unit is often a major cause of system downtime. For instance, CPU cache errors are demonstrated to be a large contributor (in many cases, the greatest contributor) to unplanned system downtime. Furthermore, addition or modification of CPU resources is among the highest-ranking causes of planned hardware downtime. But in the rp8400, HP has designed specific features to combat CPU-caused downtime, including:

- full error checking and correcting (ECC) on all caches
- automatic deconfiguration of “faulty” CPUs—known as dynamic processor resilience (DPR)
- a highly effective and reliable CPU cooling scheme
- CPU “hot-spares” using HP’s instant capacity on demand (iCOD)
- redundant CPU power converters

ECC on caches

The CPU caches in the rp8400 are fully protected from single-bit hard errors and random soft errors generated from cosmic rays or other intermittent error-generation sources. Some competitive systems in the same class are not similarly protected, resulting in errors that are hard to debug and that are in many cases blamed on the customer environment. Such cache errors in these unprotected systems can result in failures that bring down multiple partitions.

Another advantage of the rp8400’s CPU cache is its layout, which significantly reduces the chance of a multi-bit error due to a random cosmic ray strike. Such attention to detail is not found in many designs available from other vendors.

automatic CPU deconfiguration

Dynamic processor resilience (DPR) refers to the ability of the system to detect and de-allocate CPUs that are generating an excessive quantity of recoverable cache errors. This protects the customer against the extremely unlikely event of a double-bit cache error, preventing the error from occurring and causing downtime.

Here’s how DPR works:

1. Processor detects single-bit error in data cache and vectors to processor-dependent code (PDC).
2. PDC generates a low-priority machine check (LPMC).
3. LPMC handler logs information to diag2 driver.
4. Diaglogd daemon pulls LPMC log information from diag2 and passes it to the HP Event Monitoring Service (EMS) LPMC monitor.
5. If there have been too many LPMCs within 24 hours, CPU is de-allocated (online). If iCOD machine, online replacement is found.
6. System firmware is called to have PDC disable the processor the next time the system boots.
7. Event is generated to notify customer and HP.

This functionality is currently available for all CPUs in a partition except for the Monarch CPU. (The Monarch processor refers to one processor that is selected during system boot and given special boot and interrupt responsibilities.) Although the Monarch CPU will continue to correct cache errors “on the fly,” it is not de-allocated until the next reboot. A future operating system release will allow DPR of the Monarch processor.

CPU cooling

Heat is the big enemy of electronic components. But the rp8400's two-level cooling scheme offers outstanding cooling capacity at a nominal cost. The server's turbo-cooler fans draw air directly into the heat sinks of the CPU and cell VLSI. At the extreme operating ranges of the rp8400, the turbo-cooler fans keep temperatures well below the maximum values allowed. Even though the turbo-coolers may not be required under normal operating conditions, running them ensures the silicon chips operate at the lowest temperature, ensuring maximum lifetime.

To further improve reliability of the rp8400, manageability software monitors the speeds of all fans, including turbo-cooler fans. The rp8400 Smartfan controller can detect the first hint of slowdown associated with bearing wear, ensuring you get plenty of warning before a fan fails.

iCOD

Instant capacity on demand (iCOD, also referred to as "pay per use") is a means of adding and removing CPUs in a partition. With iCOD, you don't need to worry about:

- interleaved memory
- application-locked memory
- server "switchovers" due to false failures
- physically handling CPU or memory boards
- rebooting

iCOD is the most reliable means of reducing planned downtime for hardware upgrades.

redundant CPU power

In the rp8400, CPU power is protected through redundancy of the local dc-dc power conversion for the CPUs.

memory protection

Main memory failures are the single largest cause of customer downtime. The rp8400 has several features designed to reduce or eliminate failures of memory:

- "chip kill" tolerance
- dynamic memory resiliency (DMR)
- automatic deconfigure on reboot
- hardware memory scrubbing

chip kill tolerance

"Chip kill" tolerance is the ability of the system to continue to run in the face of any single- or multi-bit chip error on a DRAM. The DRAMs in the rp8400 are basically N+1 per set of 128 DRAMs per memory word. This functionality is essential in the design of reliable memory systems, and systems without this feature are doomed to fail at an alarming rate compared to the rp8400. (This has been demonstrated at customer sites that use both chip kill tolerance and less reliable architectures.)

There are many ways that DRAMs can fail, especially when a system has hundreds of them! It is hopeless to try to design around (or explain away) this simple fact. With N+1 DRAMs, the rp8400 memory is extremely reliable.

dynamic memory resiliency

Dynamic memory resiliency is the system's ability to de-allocate failed memory pages online. This feature is similar to dynamic processor resiliency; if a location in memory proves to be questionable (that is, exhibits persistent errors), the memory is de-allocated online with no customer-visible impact. Assuming the rp8400 is equipped with adequate memory to begin with, it is likely that the failed memory will never have to be replaced over the life of the product, resulting in a significant reduction in both planned and unplanned downtime.

protection for I/O

I/O errors are another significant cause of hardware errors and downtime because:

- the number of I/O cards in a typical system is significant
- the I/O cards themselves are a part of the system most exposed to frequent human interaction in the data center

In order to prevent downtime due to I/O errors, HP has designed the following features into the rp8400:

- online replacement of PCI cards
- hardware “firewall” of I/O errors to cell
- high-MTBF (mean time between failures) I/O cards
- separate PCI buses for each I/O card

Taken together, these features will reduce hardware downtime by at least 20 percent over similar servers.

online replacement of PCI cards

PCI cards in the rp8400 can be added and replaced online at introduction, with delete capability planned for a future HP-UX release. Online replacement reduces planned downtime by allowing the online addition of resources to a running system and the ability to replace a failed card without bringing down the system.

hardware “firewall” to limit I/O errors

No I/O card in the rp8400 shares a PCI bus with any other card. In other words, all I/O cards are logically and electrically isolated from all other PCI cards. This significantly improves performance, reduces the likelihood of I/O errors, and confines errors to a single PCI bus and card.

high-MTBF I/O cards

HP’s I/O cards are extensively qualified to work in our servers. This means stringent MTBF goals and full interoperability testing of all I/O cards: no incompatible drivers, no bad pointers, and no marginal signal quality.

crossbar backplane protection

The backplane ties CPU and memory together. Because all partitions share the backplane, high reliability and true domain isolation are very important. The specific features that address these areas are:

- highly reliable ASICs
- redundant dc-dc converters
- full end-to-end error correction and independent-partition design

reliability in the cabinet infrastructure

highly reliable ASICs

The backplane ASIC is manufactured and tested with a process that results in 10X demonstrated reliability over comparable chips. This reliability results in virtually zero backplane ASIC failures in the field.

redundant dc-dc converters

The dc-dc converters that power the backplane chips are fully redundant, reducing downtime associated with power conversion. (Power conversion is normally a significant contributor to failure rate.)

full end-to-end error correction and independent-partition design

The backplane is built from a single crossbar with point-to-point connections. Traffic within a partition is contained to that partition, so there is no sharing of links in a properly configured system. Each port of the crossbar chip is fully independent, allowing cells of different partitions to coexist without affecting each other in any way. In other bus-based systems, all domains participate in the coherency scheme and share address buses. Therefore, in these systems all domains are linked in some fashion, resulting in shared failure modes that might crash multiple partitions.

Also, unlike other snoopy coherency systems that must accept and respond to all coherency requests from all domains, rp8400 partitions have hardware firewalls dedicated to guarding partitions from errant transactions generated on failing partitions. A failure in one rp8400 partition will not affect any other partitions.

Finally, all data paths in the fabric are resistant to both random single-bit errors and persistent single-wire “stuck-at” faults. Therefore, the fabric is resilient to any single-bit failure, including pin, connector, or solder problems.

In keeping with its focus on maintaining high availability (HA), the rp8400 includes protection against failure within the cabinet infrastructure. The HA features in this area include:

- true dual ac line cord support
- complete resilience to service processor failures

dual ac line cord support

As described earlier in this paper, the rp8400 server can run on one or two totally independent power sources. Moreover, these two power sources don’t need to be in phase.

resilience to service processor failures

The rp8400 hardware has been designed to enable service processor failover when redundant core I/O cards are in place. Future firmware and manageability code releases will allow a slave service processor to take over for a failed master and will also enable a resilient console (on reboot). Future OS releases may allow the console to fail-over as well.

serviceability

HP continues to make great strides in implementing features that reduce the time to upgrade components or diagnose and repair component failures. The rp8400 server was designed with the objective of coupling state-of-the-art diagnostic tools with hardware features to virtually eliminate unplanned downtime. Hot-swap/-plug technology is implemented throughout the server, allowing addition or replacement of components while the system continues to run.

For components that cannot be serviced while the server is running, the rp8400 was designed to provide access and removal of any field-replaceable unit (FRU) within 15 minutes or less. In addition, the rp8400 server is loaded with design innovations that greatly simplify servicing.

enhanced serviceability

The following is a list of rp8400 enhanced serviceability features:

- hot-plug functionality for internal disks, PCI cards, removable-media drives (also, hot-plug cell boards will be enabled with a future release of HP-UX)
- hot-swap functionality for bulk power supplies and cooling fans
- product length from mounting column to the connector-mating surface at rear of 26.75 inches (~30 inches overall with the front bezel sitting forward of the rack column), leaving four inches for cable bending in third-party racks
- PCI card access from the top of the chassis so that ceiling light enhances visibility
- access panels as large as possible to enhance the service access area
- five-sided access to maximize accessibility
- independent access to major FRUs; any FRU can be accessed and removed within 15 minutes or less
- access to most commonly serviced components from the front or rear without moving the package in the rack

easy access to all components

Access on the top and sides requires the unit to slide out on slides. A lock in the slide latch prevents inadvertent sliding when the rp8400 is being moved.

The rp8400 extends 31 inches, allowing 3.5 inches of space for access to the external rear PCI cables, core I/O cables, and ac power cables. Once the chassis is extended on slides, access is achieved by the removal of the top cover and side covers held on with captive hardware.

For safety, an interlock device allows only one device to be extended at a time. A front foot and ballast system provide rack stability. (The rack ballast and front foot are required for safety.)

A large cable management arm, included with each rack-mounted server, facilitates cable dressing when the rp8400 is extended from the rack.

front access

- bulk power supplies
- front system fans
- PCI dc-to-dc converters
- hard drives
- DVD/tape drives; these devices are connected with a service loop located inside the media bay, allowing these devices to be serviced without the need for rear or side access

rear access

- rear system fans
- PCI card cables
- ac power cables
- core I/O modules and cables

right side access

- cell boards (These are located on the right side because the front door of the HP RBII rack hinges on the left. This allows the cell boards to slide out some 16 inches for removal. To shorten critical bus lengths, the cell boards are mounted upside down. To access RAM and CPUs, lay the cell board on a work surface.)
- PCI backplane (also requires top cover to be removed)
- PCI board-mounted voltage regulator modules (VRMs) (also requires removal of the top cover and structural access panel)

left side access

- system backplane (a hinged backplane secured by a single jack knob makes backplane removal independent of the PCI FRU)

top access

- PCI cards
- PCI fan modules
- mass storage backplane (held in place by two captive screws)

attractive, functional design

HP's engineers recognize that industrial design and ergonomics play an important role in serviceability, and you will find an entirely new level of design and refinement in the rp8400. Look at this list of design enhancements that make this server more attractive and more serviceable than ever before:

- industrial design refinements on molded plastic rear fan modules
- attention to industrial design on internal components such as the PCI OLR switches and paddles
- PCI fan modules molded in plastic
- positive, audible snap sound for PCI fan module installation
- internal plastic parts textured to enhance the cosmetic appearance
- painted external covers
- Barcelona blue accent color to identify user access and service areas
- large brushed aluminum handles for easy removal of bulk power supplies
- easy-access, thumb-activated latch on bulk power supplies and PCI dc-to-dc converters that provide a positive, audible snap sound upon insertion
- colorful dividers for PCI cards that also provide a handle shape for improved grip
- ergonomically sound finger access around thumbscrews on rear fan modules
- quick-release latching extractors on cell boards
- smooth, snag-free ejector surfaces integrated into card guides
- smooth, rolled sheet metal edges that eliminate possible skin injuries
- captive hardware on all major FRUs
- oversized slides that enhance stability and stoutness
- graphics-rich labels and lots of label space (731 square inches) to provide information where it's needed
- extensive use of LEDs for quick visual indication of system status and easy identification of failed components
- serpentine ac cable retention bracket designed to accommodate a large range of cable diameters (anchors the ac power cable, occupies little space, and eliminates the need for cable ties)
- four permanently attached deployment handles to facilitate field installation or removal if a lift isn't available

worry-free thermal operation

The rp8400's designers have built this server to operate over a wide range of conditions while maintaining cooling without danger of overheating. Some of the examples of enhanced thermal design include:

- self-activated spring-loaded air dampers located downstream of cell boards to block air when a cell board is not present
- gravity-dropping air dampers in the bulk power supply cave to block air when a BPS is not present
- foam baffles permanently attached to the top cover and PCI access panel so as to not get lost
- the ability to operate indefinitely with top and side panels removed (however, it is recommended that these panels be kept on during normal operation for maximum reliability and lower temperatures)
- highly accessible, field-replaceable system fans with LEDs to indicate operating status

attractive pedestal option

To provide flexibility for the customer's environment, a pedestal-mounted version of the rp8400 fits into any work area. This is a standard rp8400 with a wheel kit and dress panels; the caster wheels simply attach to holes that would otherwise be used to mount the chassis to rack slides. The wheels are located under the product to allow several units to fit close together, and all wheels have locking levers to prevent accidental movement when maintenance personnel are working on the product.

investment protection

easy upgrading

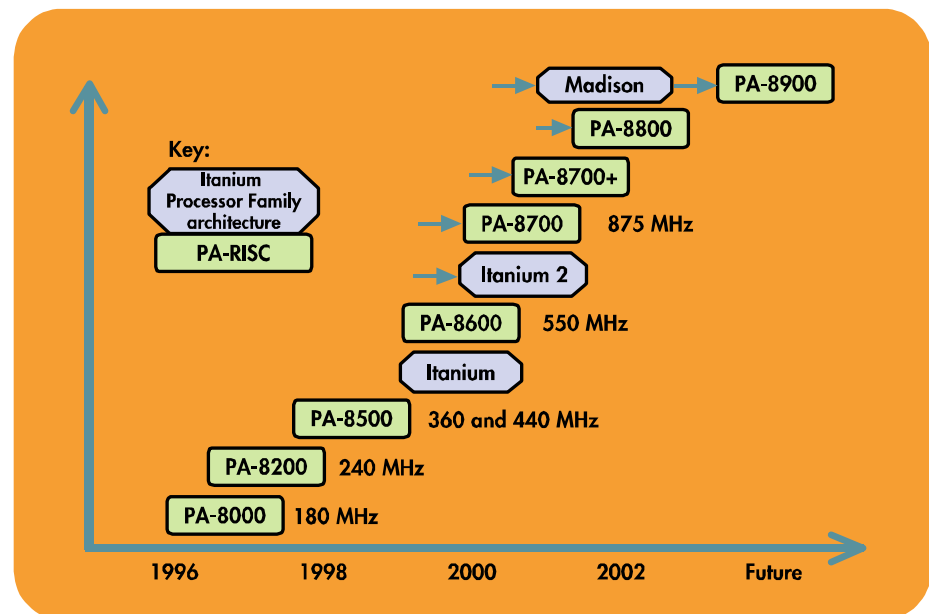
microprocessor roadmap to the future

The HP Server rp8400 family provides outstanding customer investment protection and lasting value, with a system infrastructure designed to accommodate several generations of processor upgrades. No other competitor in this space can offer the investment protection provided by the rp8400.

All major system components other than the cell board and power conversion board are slated to remain the same for future processors—you can even use the same memory DIMMs. This makes upgrading easy and economical: you simply remove all the cells and the memory contained within the cells, transfer the memory to the new processor cells, and install the new processor cells into the cabinet.

What will happen to your server investment in the future? The microprocessor roadmap in **figure 17** illustrates HP's commitment to long-term processor and architecture innovation. This commitment is your assurance HP will continue to provide the massive resources needed for your future computing requirements. In the illustration, the arrows identify processors specifically targeted for support in the rp8400.

figure 17. HP's microprocessor roadmap



You can continue to rely on binary compatibility across the PA-RISC family, enabling seamless interoperability with legacy applications on HP systems. Binary compatibility protects our customers' investments, enabling rapid growth and adoption of new technology infrastructures. In addition, customers can use existing applications and operating systems with advanced processor technology for distinct performance improvement.

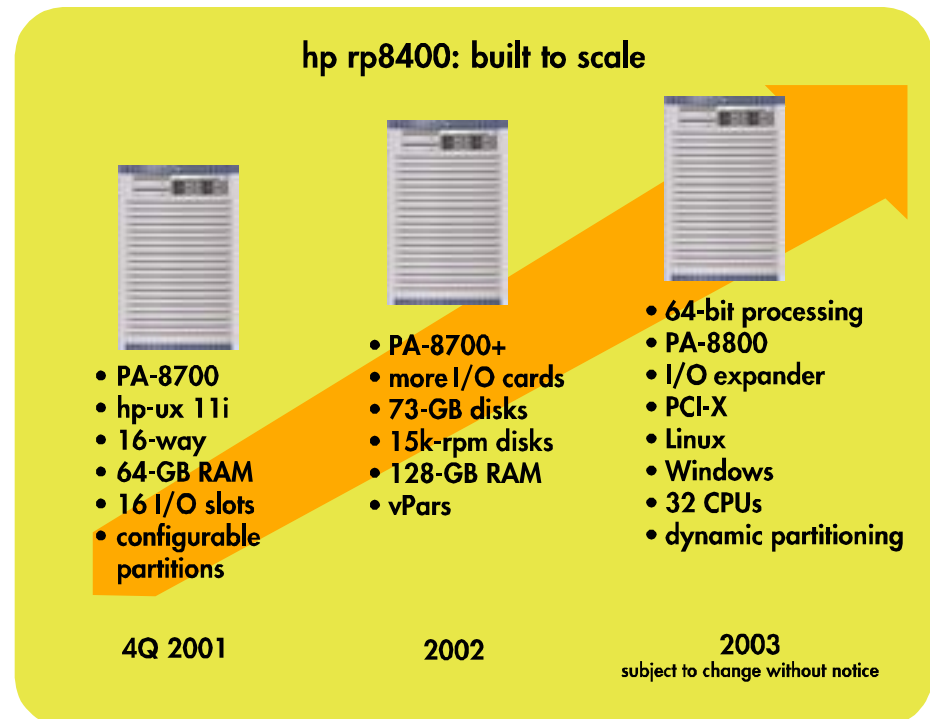
The processor roadmap shows not only a leadership line of RISC processors but also the introduction of binary-compatible processors based on the Intel Itanium Processor Family. As a result of HP's co-development work with Intel on EPIC (Explicitly Parallel Instruction Computing)—the design foundation for the Intel Itanium architecture—today's HP-UX, Windows 2000, and Linux applications will run unchanged on Intel Itanium-based platforms. For maximum performance, customers can recompile applications without source code changes.

Note, too, that HP is investing in several PA-RISC enhancements after the introduction of the Intel Itanium processor. This allows customers to move to the new architecture when they are ready, not when their vendor forces them. HP's dual-path microprocessor roadmap helps make the rp8400 the safest and fastest midrange server in the market.

hardware roadmap

In addition to the extensive processor roadmap, HP is planning many other hardware improvements throughout the rp8400's life. These in-the-box upgrades are further examples of how HP preserves customer investment protection. **Figure 18** shows HP's plans for the next few years. (And remember, this illustration doesn't show all features!)

figure 18. The HP Server rp8400 is a scalable platform that ensures investment protection for years to come.



instant capacity on demand (iCOD)

With HP's iCOD solutions, the rp8400 can be fully populated with high-performance PA-RISC CPUs at a significantly lower cost. It is no longer necessary to pay for inactive (iCOD) CPUs until the moment when you actually use them. These additional CPUs can be activated instantly with a simple command, providing immediate increases in processing power to accommodate application traffic demands.

iCOD is also a high-availability feature. In the unlikely event that a CPU fails, the HP system will automatically replace the failed CPU on the cell board at no additional charge—*without rebooting!* In online mode, the iCOD CPU brings the system back to full performance and capacity levels, reducing downtime and ensuring no degradation in performance.

HP's iCOD tools use this algorithm to activate new processors:

1. Verify that there is at least one active CPU per cell board.
2. Activate CPUs round-robin across cell boards within a partition. This means that the number of active processors per cell board will differ by at most one across the partition.
3. Enable CPUs on a cell board in the order 0, 1, 2, 3. This spreads the CPUs across the two internal cell controller buses and allocates CPUs in the best thermal fashion.
4. When a failed CPU is replaced, choose one from the same cell board when possible. If that is not possible, choose the next available CPU, following rules 2 and 3.

For best performance, all cell boards in the same partition should contain the same number of active processors. For high availability reasons, each cell board should contain at least two active processors.

ease of management

As the number of servers grows and “server farms” proliferate, IT professionals have come to realize that the cost of managing these servers can add up to many times the actual cost of hardware. In the HP Server rp8400, HP has provided features to make management easier and less taxing. Add HP’s management software that interfaces seamlessly with the rp8400, and you’re assured of a lower total cost of ownership (TCO) and higher overall efficiency.

rp8400 management processor

The rp8400 has a dedicated management processor (MP) that simplifies and extends system management and enhances serviceability. The MP feature set was designed to minimize or eliminate the need for the system administrator to be physically at the system to perform tasks such as diagnostics, system management, or even hard resets.

See page 18 of this paper for a long list of management and control functions enabled by the rp8400’s management processor.

partition manager software

The rp8400 comes with HP’s Partition Manager (parmgr) software, which makes specifying, setting up, and reconfiguring partitions easy and straightforward. You can launch Partition Manager as a GUI from HP’s System Administration Manager (SAM), or directly from command line. Some of the things you can do with Partition Manager include:

- display complex status
- create and modify partitions
- display a complete hardware inventory
- display status of key complex components
- check for problems or unusual complex conditions
- manage power to cells and I/O chassis
- turn on and off attention indicators for cells, I/O chassis, I/O cards, and cabinets

Partition Manager is another example of how HP makes server management easier than ever.

servicecontrol suite

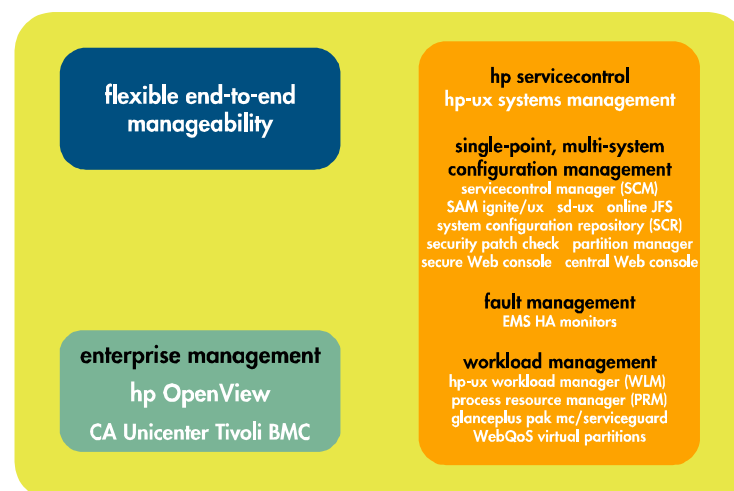
HP’s Servicecontrol suite provides increased efficiency for systems administrators through truly multi-system management tools. It provides flexible, end-to-end manageability for your entire server environment.

One important area addressed by the Servicecontrol suite is security. A concern in any IT environment—and especially important given the global reach of the Internet—security is addressed via capabilities such as role-based management and the highest degree of encryption.

Another part of Servicecontrol suite is rolling out patches, updates, and new versions, as well as keeping track of system usage, licenses, and assets. Servicecontrol suite has provision for rapid deployment and tools to enhance consistency and asset management. It also includes monitoring tools for keeping the administrator up-to-date on vital operating parameters such as performance, response time, and availability.

The Servicecontrol suite components are shown in **figure 19**.

figure 19. HP server Servicecontrol suite.



Servicecontrol suite adds up to better control for the rp8400—and to better and more profitable e-services.

operating environment

As an operating environment (OE), HP-UX 11i is a perfect complement to the rp8400 server. HP-UX 11i is HP's complete 64-bit UNIX operating environment that delivers significant scalability and performance for demanding applications. When teamed with HP's leading server systems, HP-UX 11i provides the power of supercomputing at a fraction of the cost.

The HP Server rp8400 will also support Windows and Linux in the future. And with Intel Itanium processor support, you will be able to choose among *three* operating systems—and will even be able to use a different OS in each partition.

hp-ux 11i support

HP-UX 11i blends an extraordinarily robust kernel, blazing performance, and excellent scalability with a wealth of industry-leading add-ons from HP and third-party vendors. The result is an operating system that is simply without peer for the demands of end-to-end Internet-critical computing.

The rp8400 is supported by HP-UX 11i, June 2001 release or later.

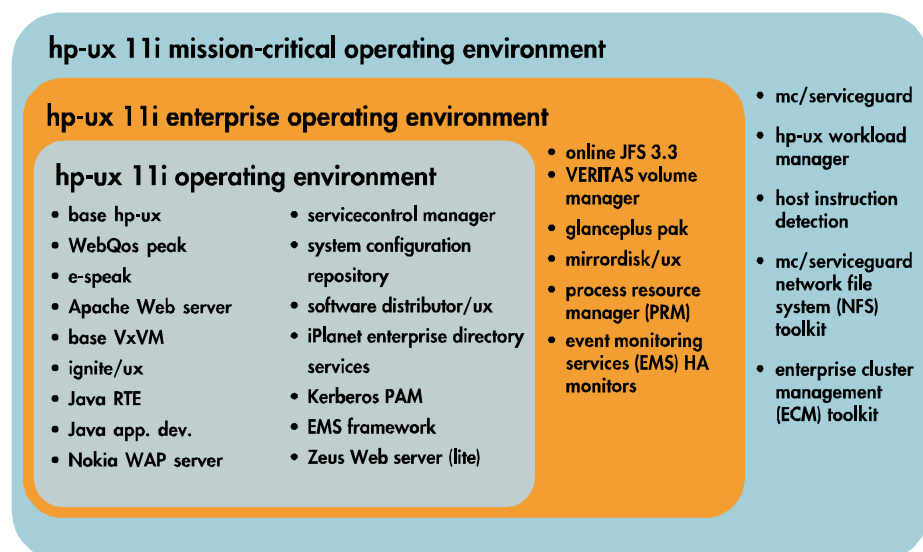
key hp-ux 11i features

- **performance**—scalability up to 64-way SMP, TPC benchmark disclosures, 4-GB large-process data space, threads support in FSS and 32-/64-bit DCE library, MxN threads for increased Java™ performance
- **security**—HP IDS 9000, execute-protected stack, Common Data Security Architecture (CSDA)
- **availability**—online addition and replacement of I/O and networking cards, dynamically tunable kernel parameters, up to 70 percent shorter system boot time
- **manageability**—static partitions on rp8400, desktop management interface (DTMI), Process Resource Manager physical memory control, Process Resource Manager disk bandwidth support
- **file systems**—VERITAS (JFS) 3.3, JFS ACL support
- **networking**—NFS over TCP/IP, Cache FS, libc pre-enablement of DNS 8.X, libc IPv6 pre-enablement
- **I/O**—Tachlite Fibre Channel
- **internationalization**—EURO: ISO 8859-15 and 10646
- **graphics**—X11R6.3 server and runtime libraries
- 2.0X OS quality improvement over HP-UX 11.0
- ISU/ISV forward application compatibility from 11.0

choice of hp-ux operating environments

HP's engineers have packaged HP-UX 11i in a variety of *operating environments*, each aimed at a specific type of computing. These operating environments offer more focused functionality, easier ordering, and easier maintenance, all at a lower cost. **Figure 20** shows the contents of the various HP-UX 11i operating environments.

figure 20. HP-UX 11i operating environments



hp services for the hp server rp8400

design, migrate, and integrate—planning well and starting fast

consulting and readiness
analysis services

integration and partitioning
services

hp startup integration
express service

hp onsite partitioning
service

education services

The success of your always-on computing environment depends on the right combination of technology products and services to ensure that you have the infrastructure and processes to meet your needs. HP services and support help customers derive real value from their IT investments through a broad services portfolio that includes consulting, outsourcing, support, financing, and education.

HP's industry-leading services portfolio offers a comprehensive set of services for midrange servers that address all phases of a customer's IT infrastructure lifecycle:

- **design**—plan and design for a solution that is tailored to fit your business
- **migrate and integrate**—fast integration and installation for a ready-to-run infrastructure
- **run**—ongoing operational excellence with mission critical services and technologies
- **evolve**—continuous care to meet your needs throughout the life of your business

HP offers a wide range of industry-leading services to help you plan and design for a solution that is tailored to your business. We also offer the following services to help you integrate and install quickly for a ready-to-run infrastructure.

To address your service level requirements efficiently and effectively, HP offers a complete set of consulting services for the analysis, design, and implementation of your IT infrastructure, processes, and organization. Whether you are looking to implement a new application or service, consolidate your IT environment, or improve your service levels, HP consulting services can help you.

HP's readiness analysis services examine your readiness to implement, design, and support your HP Server rp8400 along with its business or technical applications. By assuring that everything is in place and no detail has been overlooked, HP assists you in flawless and timely execution of your rp8400-based projects. These services provide an option of either a high-level or more detailed analysis of your IT infrastructure, applications, staff, and key IT processes.

HP offers a full set of global integration, configuration, partitioning, and installation services for HP and multivendor equipment. You can receive a pre-integrated, partitioned, configured, and tested system that minimizes your time to production, or you can choose the flexibility of having all the components integrated and configured onsite. To support the rp8400's partitioning capabilities, these services will help you to implement an enterprise cluster with multiple operating environments that can support a highly available application or run as standalone systems.

Startup integration is the highest level of integration service available from HP. It is a consulting service that provides detailed design and integration, partitioning, and configuration of HP Server rp8400 components to optimize performance and high availability. A certified HP Consultant works with the customer to understand requirements and make technical specification recommendations for a custom-designed solution. The solution is integrated and "out-of-the-box" ready when it arrives at the customer site. This service includes:

- consulting service to custom-design the detailed server configuration to meet customer needs
- final validation of the quote and order
- all of the integration services provided by the Smartset service, as described below
- onsite post-installation consulting to connect to the network, transfer knowledge, and ensure customer satisfaction

Since many customers don't want or need a partitioned server at initial shipment, this service allows the customer to implement a partitioned server environment in the field at some point after delivery and setup. It includes:

- hardware and software environment assessment for partition readiness by HP specialist at the customer site
- customer requirements gathering and optimal partition design
- installation and configuration of partitions and iCOD, if needed
- documentation and training

HP's education services provide complete curriculums to enhance the skills and knowledge of your IT professionals. Delivered on your terms, in your language, and at your convenience, HP utilizes the learning technology that's right for you—from classrooms to the Internet, from customized consulting to turnkey solutions.

run and evolve—keeping help at hand

standard support and industry-leading mission critical services

World-class services and support help you maximize the return on your IT investment and reduce your total cost of ownership. HP provides multivendor services and support to ensure a single source of accountability for complex, multivendor environments—hardware, software, storage, networks, databases, and middleware.

HP's high-quality hardware and software support, ranging from standard support to mission critical services, enables you to increase your productivity, the availability of your computing environment, and the return on your system investment. With standard support, you receive complete software maintenance and the flexibility to choose the hardware response time and coverage periods. HP's industry-leading mission critical services provide proactive services that focus on anticipating potential problems before they occur, and they ensure fast problem resolution.

critical systems support

To support the flexibility and scalability of your always-on Internet infrastructure, HP Critical Systems Support (CSS) is the recommended service level for most HP Server rp8400 customers. CSS is the optimal level of support when your business runs critical applications and is severely affected by unplanned downtime. CSS provides technical expertise through an integrated combination of proactive services and fast problem resolution. HP helps you meet your availability and performance requirements through features that include an assigned account team, a detailed account-specific support plan, change management assistance, readiness assessments, and a six-hour call-to-repair hardware commitment.

business continuity support

HP Business Continuity Support (BCS) is the most comprehensive high availability support program HP offers. This service includes an assigned team of engineers, a customized plan of services specifically designed to eliminate downtime, and industry-leading tools and technologies geared to raise the productivity of your environment. BCS customers receive top priority from HP laboratories, HP management, and HP response centers to ensure systems are performing as designed. BCS customers also receive preventive and proactive support coupled with the fastest, most customized restoration commitment available today.

support for your data storage

For your HP storage environment, HP offers new mission critical storage services that provide proactive and preventive services—including a "100% data availability guarantee" for your HP Disk Array XP.

business recovery services

HP Business Recovery services complete the fully-integrated mission critical solution that helps ensure the continuity of your business against all possible causes of unplanned downtime, including natural and other disasters.

outsourcing services

HP's outsourcing services can help you improve productivity, manage costs and assets, improve customer service, and capitalize on market changes. HP can provide the key operations management and support needed to run an always-on infrastructure.

key takeaways

Packed with leadership features that provide real value for customers in a variety of markets, the HP Server rp8400 is adaptable, available, and always ready for the next computing challenge. No other system offered by the competition can match the combined feature set of the rp8400. No matter what your midrange server requirements, the rp8400 can step in and do the job—today and tomorrow.

It's difficult to distill all the features of the HP Server rp8400 into a few sentences. But here are six important points to keep in mind:

- 1. The rp8400 is HP Superdome architecture leveraged into the midrange**—The best of Superdome was leveraged into the rp8400. The result: a server that extends the midrange envelope well beyond what the competition can achieve.
- 2. The rp8400 offers best-in-class performance density**—The compact design and high performance of the rp8400 offer industry-leading performance density at 280+ TPM in a single cabinet. Think about the competition—they need at least 2–4 cabinets to match that performance!
- 3. The rp8400 has leadership high availability**—The rp8400 has robust availability features in virtually every part of the system. Think about the components that are most likely to fail in a system; the rp8400 ensures that none of these components will cause system failure. The competition claims to have “full hardware redundancy.” But a close look will show you that redundancy doesn't mean protection from system failures.
- 4. The rp8400 features industry-leading partitioning**—No other midrange server offers the level of nPartitions and vPars found in the rp8400.
- 5. The rp8400 ensures configuration flexibility**—The rp8400 offers customers a wide range of options to match their particular needs. Each system can be configured as a single large SMP or split into two hardware-independent partitions. In addition, the rp8400 offers the widest selection of I/O cards, memory, and disk sizes, all without the configuration trade-offs found in competitive systems.
- 6. The rp8400 is built to scale**—Built for today and tomorrow, the rp8400 offers investment protection with a clear path to future upgrades. Larger, faster disks, more I/O cards and PCI-X performance, double the memory capacity, advanced manageability features, multiple PA and IPF processors—the future is loaded with enhancements that offer customers real increases in performance, scalability, and availability.

for more information

For more information, please visit our Web site at www.hp.com/go/servers and www.hp.com/go/rp8400

Full information on HP Products is available at **www.hp.com**

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